

**EPA Superfund
Record of Decision:**

**ABERDEEN PROVING GROUND (MICHAELSVILLE
LANDFILL)
EPA ID: MD3210021355
OU 04
ABERDEEN, MD
09/27/1991**

Text:

THIS DECISION DOCUMENT PRESENTS A DETERMINATION THAT NO REMEDIAL ACTION WILL BE TAKEN AT THIS TIME FOR THE WHITE PHOSPHORUS UNDERWATER MUNITIONS BURIAL AREA (WPUMBA) AT THE US ARMY ABERDEEN PROVING GROUND, MARYLAND. THIS DETERMINATION WAS DEVELOPED IN ACCORDANCE WITH THE COMPREHENSIVE ENVIRONMENTAL RESPONSE, COMPENSATION AND LIABILITY ACT OF 1980 (CERCLA), AS AMENDED BY THE SUPERFUND AMENDMENT AND REAUTHORIZATION ACT OF 1986 (SARA), 42 USC SECTION 9601 ET SEQ. AND THE NATIONAL CONTINGENCY PLAN (NCP) 40 CFR PART 300. THIS NO ACTION DECISION IS SUPPORTED BY DOCUMENTS CONTAINED IN THE ADMINISTRATIVE RECORD. THE STATE OF MARYLAND HAS CONCURRED ON THE NO ACTION DETERMINATION.

DATE
09/12/1991

RONALD V. HITE
BRIGADIER GENERAL, US ARMY
COMMANDING
ABERDEEN PROVING GROUND

DATE
09/24/1991

LEWIS D. WALKER
DEPUTY FOR ENVIRONMENT, SAFETY, AND
OCCUPATIONAL HEALTH OFFICE OF THE ASSISTANT
SECRETARY OF THE ARMY US DEPARTMENT OF THE
ARMY

DATE
09/27/1991

EDWIN B. ERICKSON
REGIONAL ADMINISTRATOR
US ENVIRONMENTAL PROTECTION AGENCY - REGION III

#SRAS
SUMMARY OF REMEDIAL ACTION SELECTION

WHITE PHOSPHORUS UNDERWATER MUNITIONS BURIAL AREA
US ARMY ABERDEEN PROVING GROUND, MARYLAND

#SD
SITE DESCRIPTION

US ARMY ABERDEEN PROVING GROUND (APG) OCCUPIES SOME 79,000 ACRES OF LAND AND WATER IN SOUTHERN HARFORD COUNTY AND SOUTHEASTERN BALTIMORE COUNTY, MARYLAND, NEAR THE HEAD OF THE CHESAPEAKE BAY (SEE FIGURES 1 & 2). IT IS OWNED AND OPERATED BY THE US DEPARTMENT OF THE ARMY (ARMY) AND IS AN ACTIVE ARMY TEST AND EVALUATION INSTALLATION PRIMARILY RESPONSIBLE FOR PLANNING AND TESTING OF WEAPONS, MUNITIONS, VEHICLES, AND VARIOUS EQUIPMENT. APG CONSISTS OF TWO FUNCTIONAL AREAS: THE EDGEWOOD AREA (13,000 LAND ACRES, INCLUDING GUNPOWDER NECK, POOLES ISLAND, CARROLL ISLAND, AND GRACES QUARTERS) AND THE ABERDEEN AREA (17,000 LAND ACRES, INCLUDING MICHAELSVILLE AND PHILLIPS LANDFILLS). THE LAND PORTIONS OF THE TWO AREAS ARE SEPARATED BY THE BUSH RIVER. (SEE FIGURE 3)

THE ABERDEEN AREA IS BORDERED ON THE WEST BY THE BUSH RIVER AND NORTHEAST TO SOUTH BY THE CHESAPEAKE BAY. THE AREA IS DRAINED BY SEVEN CREEKS PLUS THE BUSH RIVER. MOST OF THESE CREEKS HAVE THEIR HEADWATERS ON THE ABERDEEN AREA. THE ARMY FACILITIES IN THE ABERDEEN AREA INCLUDE FIRING RANGES, IMPACT AREAS, VEHICLE TEST TRACKS, AND LABORATORIES IN SUPPORT OF TESTING ACTIVITIES.

THE WHITE PHOSPHORUS UNDERWATER MUNITIONS BURIAL AREA (WPUMBA) IS LOCATED OFFSHORE OF THE ABERDEEN AREA OF APG, MARYLAND, ON THE WESTERN SIDE OF THE UPPER CHESAPEAKE BAY. THE AREA IS SITUATED IN SHALLOW WATERS JUST BEYOND THE MOUTH OF MOSQUITO CREEK, BETWEEN BLACK POINT AND GULL ISLAND (SEE FIGURE 4). SPESUTIE NARROWS AND SPESUTIE ISLAND LIE TO THE NORTH AND NORTHEAST, RESPECTIVELY. THE OPEN WATER AREA OF APG

TOTALS APPROXIMATELY 37,000 ACRES OF WHICH 15 ACRES OF OPEN WATER COMPRISE THE SUPPOSED WPUMBA.

BASED ON INTERVIEWS OF FORMER EMPLOYEES WHO WORKED ON THE POST FOLLOWING WORLD WAR I, AN UNKNOWN AMOUNT OF WORLD WAR I WHITE PHOSPHORUS MUNITIONS (ORDNANCE) WERE SUPPOSEDLY BURIED IN THE CHESAPEAKE BAY IN THE VICINITY OF BLACK POINT DURING THE PERIOD 1922-1925. THE ORDNANCE REPORTEDLY CONSISTED OF UNITED STATES, BRITISH, AND FRENCH LAND MINES, GRENADES, AND ARTILLERY SHELLS. ACCORDING TO THE INTERVIEWS, BULK PHOSPHORUS MAY ALSO HAVE BEEN DISPOSED IN THE BAY. IT IS POSSIBLE THAT THIS DISPOSAL EVENT INVOLVED A SINGLE BARGE LOAD OF MUNITIONS; HOWEVER, IT MAY HAVE INVOLVED CONSIDERABLY MORE. IN 1933, THE WPUMBA WAS REPORTEDLY UNCOVERED BY A STRONG HURRICANE, WHICH LED TO A LARGE WATERFOWL KILL, WHERE DUCKS SUPPOSEDLY "TURNED PINK AND DIED."

THE US ENVIRONMENTAL PROTECTION AGENCY (EPA) ISSUED APG A RESOURCE CONSERVATION AND RECOVERY ACT (RCRA) CORRECTIVE ACTION PERMIT, ON SEPTEMBER 30, 1986, AS MODIFIED ON SEPTEMBER 26, 1988. THE EPA AND THE ARMY ENTERED INTO A COMPREHENSIVE ENVIRONMENTAL RESPONSE, COMPENSATION, AND LIABILITY ACT (CERCLA), SECTION 120 INTERAGENCY AGREEMENT (IAG) ON MARCH 27, 1990, TO COORDINATE AND PROVIDE FOR ALL CERCLA/RCRA CORRECTIVE ACTION ACTIVITIES AT APG. IN THIS IAG, THE ARMY AND EPA AGREED THAT ALL AREAS WHICH WERE IDENTIFIED AS RCRA CORRECTIVE ACTION STUDY AREAS WOULD BE INVESTIGATED AND, IF NECESSARY, REMEDIATED PURSUANT TO CERCLA. THE WPUMBA WAS IDENTIFIED AS A RCRA CORRECTIVE ACTION STUDY AREA.

#SH SITE HISTORY

THE ABERDEEN AREA OF APG WAS ESTABLISHED IN 1917 AS THE ORDNANCE PROVING GROUND. TESTING OF AMMUNITION BEGAN IN JANUARY OF 1918. LARGE SEGMENTS OF THE OPEN WATER SURROUNDING THE ABERDEEN AREA HAVE BEEN USED AS ORDNANCE IMPACT AREAS SINCE 1917. THERE ARE AN ESTIMATED FOUR MILLION UNEXPLODED AND SIXTEEN MILLION INERT PROJECTILES OF ALL CALIBERS IN THE RESTRICTED WATERS OFF APG.

THE WPUMBA IS ADJACENT TO AND OFFSHORE OF THE MAIN FRONT LAND RANGE AREA, WHICH HAS BEEN ACTIVE SINCE 1917. AN ESTIMATED ONE MILLION ROUNDS OF ALL CALIBERS UP TO 16 INCHES HAVE BEEN FIRED AT THIS RANGE. THE TYPES OF ROUNDS FIRED INCLUDE HIGH EXPLOSIVES, ANTI-PERSONNEL, ARMOR DEFEATING, INCENDIARY, SMOKE, AND ILLUMINATING. ALTHOUGH THE WPUMBA IS ADJACENT TO THIS RANGE, THERE ARE NO RECORDS OF THE OPEN WATER AREAS OF THE WPUMBA HAVING BEEN USED AS AN IMPACT AREA.

NO EVIDENCE OF A DISPOSAL SITE AT THE WPUMBA WAS OBSERVED IN ANY HISTORICAL AERIAL PHOTOGRAPHS REVIEWED. HOWEVER, ONE REFERENCE TO A PHOSPHORUS AREA WAS FOUND IN PROCLAMATION 2383, SIGNED BY PRESIDENT FRANKLIN D. ROOSEVELT ON JANUARY 24, 1940. UNDER THE AUTHORITY OF THE MIGRATORY BIRD ACT OF 1918 (40 STAT. 755, 16 USC 704), THE ACTING SECRETARY OF THE INTERIOR ADOPTED A REGULATION ON DECEMBER 12, 1939, WHICH DESIGNATED TWO AREAS AS MIGRATORY WATERFOWL CLOSED AREAS. ONE OF THE AREAS APPROVED BY THE SUBSEQUENT PROCLAMATION WAS AT APG AND WAS REFERRED TO AS THE "PHOSPHORUS AREA UNIT." THIS PROCLAMATION IS THE ONLY WRITTEN DOCUMENT FOUND THAT SPECIFICALLY MENTIONS PHOSPHORUS AND DELINEATES THE BOUNDARY OF A SPECIFIC AREA. THE SIZE OF THIS "PHOSPHORUS AREA UNIT" ENCOMPASSES APPROXIMATELY 130 ACRES. IT IS ASSUMED THAT THE AREA DESCRIBED INCORPORATED THE WPUMBA.

DURING 1988-1989, THE EPA'S ENVIRONMENTAL RESPONSE TEAM (ERT) AND ENVIRONMENTAL MONITORING SERVICE LAB CONDUCTED EXTENSIVE ELECTROMAGNETIC AND CORE SAMPLING STUDIES OF THE WPUMBA. THE EPA ERT INVESTIGATION WAS CONDUCTED AS A CERCLA REMEDIAL INVESTIGATION TO ANSWER QUESTIONS RELATED TO; THE LOCATION OF THE WPUMBA; POSSIBLE RELEASES TO THE ENVIRONMENT SURROUNDING THE SUPPOSED BURIAL SITE; POTENTIAL ADVERSE EFFECTS TO THE ENVIRONMENT, AQUATIC ORGANISMS, HIGHER FOOD CHAIN ORGANISMS, AND HUMAN HEALTH THAT COULD RESULT SHOULD THERE BE A RELEASE FROM THE AREA; THE

EXTENT TO WHICH ANY PAST, PRESENT, OR FUTURE DREDGING ACTIVITIES MAY CONTRIBUTE TO RELEASES FROM THIS AREA; AND MEET THE REQUIREMENTS OF THE IAG.

SEVERAL TECHNIQUES WERE USED DURING THE INVESTIGATION TO DETERMINE THE LOCATION OF THE WPUMBA. A LITERATURE SEARCH WAS CONDUCTED TO LOCATE RELATED INFORMATION CONCERNING THE DISPOSAL, STORAGE, AND HANDLING OF WHITE PHOSPHORUS. APG RECORDS, HISTORICAL MAPS, AND AERIAL PHOTOS WERE REVIEWED. MANUFACTURERS, FORMER EMPLOYEES, AND HISTORIANS (NATIONAL ARCHIVES, LIBRARY OF CONGRESS, US ARMY ARCHIVES) WERE ALSO CONTACTED FOR RELEVANT INFORMATION. AN IN-DEPTH GEOPHYSICAL INVESTIGATION AT THE SITE WAS CONDUCTED IN OCTOBER, 1988, FOLLOWED BY AN ADDITIONAL GEOPHYSICAL SURVEY IN JUNE OF 1989.

BASED ON THE 1988 GEOPHYSICAL DATA, FOUR AREAS WERE SELECTED AS BEING HIGHLY PROBABLE LOCATIONS FOR THE WPUMBA, AND SEDIMENT CORE SAMPLING WAS SCHEDULED FOR THOSE AREAS. A FIFTH AREA, THE CHANNEL ADJACENT TO THE WPUMBA, WAS SELECTED FOR CORING DUE TO MAINTENANCE DREDGING CONCERNS. A REFERENCE AREA WAS ALSO SELECTED NORTH OF THE SITE IN SPESUTIE NARROWS. DUE TO THE SAFETY CONCERNS IN DEALING WITH THE BURIAL AREA AND THE KNOWN PRESENCE OF UNEXPLODED ORDNANCE ON APG, A REMOTE CORING OPERATION WAS NECESSARY.

A TOTAL OF 60 CORES WERE COLLECTED DURING AUGUST OF 1989, RANGING IN DEPTH FROM 1 TO APPROXIMATELY 9 FEET. CORES WERE SCREENED ON-SITE FOR HIGH EXPLOSIVES AND COMPOSITE SAMPLES WERE COLLECTED FOR ANALYSIS. ALL SAMPLES WERE ANALYZED FOR ELEMENTAL PHOSPHORUS, HIGH EXPLOSIVES, AND RCRA HAZARDOUS WASTES. SELECT SAMPLES WERE ANALYZED FOR TOTAL ORGANIC CARBON, GRAIN SIZE, AND TOXICITY. WATER SAMPLES WERE ALSO COLLECTED AT EACH OF THE AREAS CORED AND ANALYZED FOR ELEMENTAL PHOSPHORUS AND HIGH EXPLOSIVES. WATER QUALITY MEASUREMENTS WERE RECORDED IN EACH AREA AND INCLUDED TEMPERATURE, PH, CONDUCTIVITY, SALINITY, OXIDATION-REDUCTION POTENTIAL, AND DISSOLVED OXYGEN.

GULL ISLAND, WHICH IS LOCATED ALONG THE EASTERN BORDER OF THE WPUMBA, WAS EXAMINED AS A POTENTIAL PAST DISPOSAL SITE FOR WHITE PHOSPHORUS. A GEOPHYSICAL SURVEY WAS CONDUCTED IN LATE OCTOBER OF 1988 TO LOCATE ANY POTENTIALLY BURIED FERROUS METALS. SEVERAL TEST PITS WERE EXCAVATED TO EXAMINE THE STRATIGRAPHY AND SOILS OF THE ISLAND. SOIL CORES WERE COLLECTED DURING SEPTEMBER OF 1989 FROM THE NORTH AND SOUTH ENDS OF THE ISLAND AND ANALYZED FOR ELEMENTAL PHOSPHORUS, HIGH EXPLOSIVES, AND GRAIN SIZE.

BASED ON THE RESULTS OF THE EPA ERT STUDY, THE BOUNDARIES OF THE WPUMBA COULD NOT BE DISCERNED. THE GEOPHYSICAL INVESTIGATION SHOWED ONLY A MINOR DISTRIBUTION OF MAGNETIC OBJECTS, AND INTRUSIVE SEDIMENT CORE SAMPLING REVEALED ONLY SPORADIC OCCURRENCES OF DETECTABLE LEVELS OF PHOSPHORUS. RESULTS INDICATE THAT TRACE AMOUNTS OF PHOSPHORUS WERE DETECTED IN 11 OF THE 60 CORE SAMPLES, WITH THE DETECTED SINGLE MAXIMUM OCCURRENCE BEING LESS THAN 5 G/KG (SEE TABLE 1). NO PHOSPHORUS WAS DETECTED IN THE WATER COLUMN, OR ON GULL ISLAND. NO HIGH EXPLOSIVE COMPOUNDS WERE DETECTED IN THE WATER OR SEDIMENT SAMPLES. RCRA ANALYSES (EP TOXICITY) INDICATE THAT THE SEDIMENT WOULD NOT BE CONSIDERED A HAZARDOUS WASTE. RELEASE OF WHITE PHOSPHORUS IS NOT EXPECTED UNLESS THE SEDIMENTS ARE DISTURBED. THE LOCATION OF THE WPUMBA COULD NOT, THEREFORE, BE DETERMINED WITHIN THE CONFINES OF THE EPA ERT STUDY. LIKEWISE, BIOASSAY TECHNIQUES, UTILIZING FRESHWATER AND ESTUARINE FISH, DID NOT ELUCIDATE ANY CLEAR TOXIC EFFECT OF WHITE PHOSPHORUS ON AQUATIC LIFE.

COMMUNITY PARTICIPATION

TO PROVIDE THE COMMUNITY WITH REASONABLE OPPORTUNITY TO SUBMIT WRITTEN AND ORAL COMMENTS ON THE PROPOSED PLAN FOR THE WHITE PHOSPHORUS UNDERWATER MUNITIONS BURIAL AREA AND THE US EPA ENVIRONMENTAL RESPONSE TEAM'S (ERT) REPORT, ENTITLED "FIELD INVESTIGATION OF THE WHITE PHOSPHORUS MUNITIONS BURIAL AREA, ABERDEEN PROVING GROUND, MARYLAND - JANUARY, 1990," THE ARMY ESTABLISHED A PUBLIC COMMENT PERIOD FROM JULY 3RD THROUGH AUGUST 17TH, 1991. A PUBLIC MEETING WAS HELD ON

JULY 25, 1991 TO PRESENT THE PROPOSED PLAN AND TO ANSWER QUESTIONS AND RECEIVE COMMENTS.

THE PROPOSED PLAN, EPA ERT'S REPORT, AND THE ADMINISTRATIVE RECORD FILE WERE MADE AVAILABLE FOR PUBLIC REVIEW AT THE FOLLOWING LOCATIONS:

ON-POST

US ARMY TEST AND EVALUATION COMMAND
PUBLIC AFFAIRS OFFICE BUILDING 314
ABERDEEN AREA
ABERDEEN PROVING GROUND, MD. 21005-5001

OFF-POST

HARFORD COUNTY LIBRARY - ABERDEEN BRANCH LIBRARY
21 FRANKLIN STREET
ABERDEEN, MARYLAND 21001

HARFORD COUNTY LIBRARY - EDGEWOOD BRANCH LIBRARY
2205 HANSON ROAD
EDGEWOOD, MARYLAND 21040

LEGAL NOTICES SUMMARIZING THE PROPOSED PLAN, INFORMING THE PUBLIC OF DOCUMENT AVAILABILITY AND LOCATIONS, AND LISTING THE TIME AND PLACE OF THE PUBLIC MEETING, WERE PUBLISHED IN THE BALTIMORE SUN, THE AEGIS, AND THE APG NEWS. NO COMMENTS WERE RECEIVED BY THE EPA, STATE OF MARYLAND, OR THE ARMY DURING THE PUBLIC COMMENT PERIOD ON THE PROPOSED PLAN, ON THE EPA ERT'S REPORT, ON THE NO-ACTION ALTERNATIVE CHOSEN FOR THE WHITE PHOSPHORUS UNDERWATER MUNITIONS BURIAL AREA, OR ON THE ADMINISTRATIVE RECORD FILE. SEVERAL TECHNICAL QUESTIONS WERE ANSWERED DURING THE PUBLIC MEETING CONCERNING THE CONDUCT OF THE ERT INVESTIGATION.

#SR

SCOPE AND ROLE OF THE WPUMBA OPERABLE UNIT RESPONSE ACTION

THE INVESTIGATION OF THE WPUMBA ANSWERED QUESTIONS RELATED TO CONDITIONS AT THE UNDERWATER SITE, AND THE POTENTIAL FOR CURRENT AND FUTURE THREATS TO HUMAN HEALTH AND THE ENVIRONMENT. THE LOCATION AND EXISTENCE OF THE WPUMBA IN THE ERT STUDY AREA HAS NOT BEEN CONFIRMED, USING THE BEST AVAILABLE TECHNOLOGY. THE ARMY AND THE EPA WILL CONDUCT A REVIEW, FIVE YEARS HENCE, OF THE TECHNOLOGY AVAILABLE FOR THE DETECTION/LOCATION OF WHITE PHOSPHORUS TO DETERMINE IF ANY SIGNIFICANT ADVANCEMENT HAS OCCURRED TO WARRANT A RE-INVESTIGATION OF THE SUPPOSED BURIAL AREA.

THE LACK OF DETECTABLE QUANTITIES OF PHOSPHORUS IN THE WATER COLUMN, COMBINED WITH THE RELATIVELY LOW CONCENTRATIONS OF PHOSPHORUS FOUND IN LESS THAN 20 PERCENT OF THE SEDIMENT SAMPLES AND THE DEPTH AT WHICH PHOSPHORUS WAS DETECTED, INDICATES THAT WHITE PHOSPHORUS IS NOT BEING RELEASED INTO THE WATER COLUMN AT THE STUDY AREA. ADDITIONALLY, RCRA ANALYSES (EP TOXICITY) INDICATE THAT THE WPUMBA SEDIMENT WOULD NOT BE CLASSIFIED AS A HAZARDOUS WASTE. HOWEVER, THE "NO ACTION" REMEDY DOES NOT PROVIDE ANY PROTECTION AGAINST EXPOSURE TO WHITE PHOSPHORUS IF IT IS LATER RELEASED FROM THE YET UNDISCOVERED WPUMBA. THE "NO ACTION" REMEDY, THEREFORE, REQUIRES MONITORING OF THE WPUMBA BY THE ARMY DURING DREDGING AND FOLLOWING MAJOR STORM EVENTS.

IT IS STILL POSSIBLE, HOWEVER, THAT UNEXPLODED ORDNANCE OR OTHER SAFETY HAZARDS MAY EXIST WITHIN THE STUDY AREA. THE GOALS, THEREFORE, OF THE SELECTED REMEDIAL ACTION ARE TO LIMIT THE EXPOSURE OF THE AQUATIC ECOSYSTEM AND HUMAN POPULATION TO ANY BURIED MATERIAL CONTAINED IN THE CURRENT WPUMBA, AND ARE TO BE ACCOMPLISHED THROUGH THE ABOVE DESCRIBED MONITORING/SAMPLING PROGRAM. ADDITIONALLY, A REVIEW OF THE TECHNOLOGY AVAILABLE FOR DETECTING AND LOCATING THE SUPPOSED WPUMBA WILL BE PERFORMED IN FIVE YEARS.

THEREFORE, THE ARMY AND THE EPA HAVE AGREED THAT THE ERT INVESTIGATION DEMONSTRATED THAT THE SUPPOSED WPUMBA COULD NOT BE LOCATED IN THE STUDY AREA OUTLINE IN FIGURE 4. HOWEVER, HISTORICAL REFERENCES RECENTLY REVIEWED BY THE MARYLAND DEPARTMENT OF THE ENVIRONMENT INDICATE THE POSSIBILITY OF ANOTHER LOCATION FOR A WHITE PHOSPHORUS BURIAL SITE, IN ADDITION TO THE ERT UNDERWATER STUDY LOCATION. THE PHOSPHORUS BURIAL REPORTEDLY OCCURRED IN THE WATERFRONT REGION NEAR BLACK POINT, ENCOMPASSING AN AREA OF 15 ACRES. ONE HISTORICAL REFERENCE ALLUDES THAT WHEN DISPOSED, THE MUNITIONS WERE PLACED IN TIDAL FLATS AND COVERED WITH 2 FEET OF SEDIMENT. THE ARMY AND EPA HAVE AGREED, WITH THE ISSUANCE OF THIS RECORD OF DECISION (ROD) FOR THE WPUMBA, TO INITIATE AN INVESTIGATION OF A POSSIBLE SITE ON LAND OR IN A TIDAL MARSH NEAR BLACK POINT, TO BE DESIGNATED THE "WHITE PHOSPHORUS MUNITIONS LAND BURIAL AREA (WPMLBA)." FIGURE 5 DEPICTS THE PROPOSED NEW STUDY AREA. THE INVESTIGATION OF THE WPMLBA WILL BE INCORPORATED INTO THE OTHER ABERDEEN AREAS STUDY.

#SC

SITE CHARACTERISTICS

APG IS LOCATED ON THE NORTHWESTERN SHORE OF THE CHESAPEAKE BAY. DUE TO ITS PROXIMITY TO TWO LARGE BODIES OF WATER, THE CHESAPEAKE BAY AND THE ATLANTIC OCEAN, THE CLIMATE AT APG TENDS TO BE MODERATE AS COMPARED TO INLAND MARYLAND. THE AVERAGE TEMPERATURE FOR APG IS 54.5 DEGREE FAHRENHEIT, WITH AN AVERAGE RELATIVE HUMIDITY OF 73.8 PERCENT. PRECIPITATION AS RAINFALL AVERAGES 38.58 INCHES WITH A MAXIMUM RAINFALL OCCURRING DURING THE SUMMER AND THE MINIMUM RAINFALL OCCURRING DURING AUTUMN. PRECIPITATION AS SNOWFALL AVERAGES 12 INCHES. PREVAILING WINDS AVERAGE 6.8 KNOTS IN A NORTHWEST TO NORTH-NORTHWEST DIRECTION IN THE WINTER MONTHS, AND A SOUTH TO SOUTH-SOUTHWEST DIRECTION IN THE SUMMER MONTHS.

APG IS DRAINED BY EIGHT RIVERS AND STREAMS. SURFACE WATERS AT APG TEND TO BE SHALLOW AND SLUGGISH WITH TIDAL ESTUARIES FORMING AT THE MOUTHS OF THE STREAMS AND RIVERS. THIS IS ATTRIBUTED TO LOW LAND ELEVATIONS AND THE FACT THAT APG IS BORDERED BY THE CHESAPEAKE BAY. THE NORTHEASTERN AREA OF APG, WHICH TENDS TO BE HIGHLY DEVELOPED, IS DRAINED BY SWAN CREEK, DIPPLE CREEK, WOODREST CREEK, AND THE UPPER BRANCHES OF ROMNEY CREEK. THE SOUTHWESTERN PORTION, WHICH TENDS TO BE UNDEVELOPED AND INCLUDES SOME RANGES AND TEST AREAS, IS DRAINED BY MOSQUITO CREEK, DELPH CREEK, THE LOWER HALF OF ROMNEY CREEK, AND THE LOWER PORTION OF BUSH RIVER. SPESUTIE ISLAND, WHICH IS ALSO UNDEVELOPED AND INCLUDES TEST AREAS, IS DRAINED BY BACK CREEK.

ALLUVIUM, SWAMP AND MARSH DEPOSITS OCCUR IN THE REACHES OF THE RIVERS IN THE REGION THAT HAVE BECOME INUNDATED AS A RESULT OF A RISE IN SEA LEVEL. COMPOSITION OF THE ALLUVIUM RANGES FROM CLAY TO GRAVEL, AND THE SWAMP AND MARSH DEPOSITS CONSIST OF SILTS, CLAYS, AND ORGANIC MATTER. THUS, SURFICIAL SEDIMENTS ARE HETEROGENEOUS AND VARY CONSIDERABLY IN THE LATERAL DIRECTION. TYPICALLY, GRAVELS ARE AT THE BASE AND THE SILTS AND CLAYS DOMINATE THE UPPER PORTIONS.

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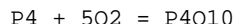
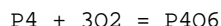
SUMMARY OF SITE RISKS

PHYSICAL AND CHEMICAL PROPERTIES OF WHITE PHOSPHORUS

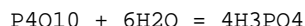
PHOSPHORUS IS A VERY REACTIVE ELEMENT, AND THUS IT IS NEVER FOUND IN THE FREE STATE IN NATURE, BUT IS WIDELY DISTRIBUTED IN MINERAL DEPOSITS. ELEMENTAL PHOSPHORUS EXISTS IN THREE ALLOTROPIC MODIFICATIONS; WHITE, RED, AND BLACK, THE MOST COMMON FORM BEING WHITE PHOSPHORUS. WHITE PHOSPHORUS, WHICH MAY HAVE A SLIGHT YELLOW HUE, IS BOTH POISONOUS AND FLAMMABLE, AND IS THE MOST REACTIVE OF THE THREE ALLOTROPES. THIS REACTIVITY MAY RESULT FROM WHITE PHOSPHORUS MAINTAINING ITS TETRAHEDRAL STRUCTURE THROUGHOUT ITS PHASE CHANGES. AT ROOM TEMPERATURE, WHITE

PHOSPHORUS EXISTS AS CUBIC CRYSTALS, CALLED THE ALPHA () FORM. WHITE PHOSPHORUS' IGNITION TEMPERATURE IS ONLY 86 DEGREE FAHRENHEIT. IT IS A SOFT, WAXY, TRANSLUCENT SOLID WHICH IS SOLUBLE IN ORGANIC SOLVENTS, SUCH AS CARBON DISULFIDE, BUT IS UNREACTIVE WITH WATER. WHITE PHOSPHORUS HAS A HIGH OCTANOL/WATER PARTITION COEFFICIENT WHICH REVEALS A POTENTIAL FOR BIOACCUMULATION, AND A HIGH VOLATILITY WHICH INDICATES SOME POTENTIAL FOR RELEASE TO THE ATMOSPHERE. ELEMENTAL WHITE PHOSPHORUS IS TETRATOMIC, HAVING A MOLECULAR WEIGHT OF 123.90, AND THE CHEMICAL FORMULA P_4 .

WHEN EXPOSED TO AIR, WHITE PHOSPHORUS FUMES AND SPONTANEOUSLY IGNITES WITH AN ODOR SOMEWHAT LIKE THAT OF A BURNING MATCH. LIKE CARBON, PHOSPHORUS BURNS AS A SOLID WITHOUT VAPORIZING. THE COMBUSTION FORMS EITHER TETRAPHOSPHORUS HEXOXIDE OR TETRAPHOSPHORUS DECOXIDE:



TETRAPHOSPHORUS DECOXIDE DISSOLVES IN WATER TO FORM THE MINERAL ACID KNOWN AS PHOSPHORIC ACID:



TO PREVENT ITS SPONTANEOUS IGNITION, WHITE PHOSPHORUS IS NORMALLY STORED UNDER WATER, WHICH KEEPS IT FROM CONTACT WITH AIR. BECAUSE OF ITS LOW IGNITION TEMPERATURE, WHITE PHOSPHORUS IGNITES SO EASILY THAT IT IS UNSAFE TO HANDLE OUT OF WATER. IT IS ALSO UNSTABLE, GRADUALLY CHANGING TO RED PHOSPHORUS, WHICH IS LESS REACTIVE.

FIRES INVOLVING ELEMENTAL PHOSPHORUS ARE EXTINGUISHED WITH WATER OR BLANKETED WITH WET SAND OR ABSORBENT. HOWEVER, IT IS IMPORTANT TO RECALL THAT THE OXIDES OF PHOSPHORUS WHICH RESULT FROM COMBUSTION ARE CAPABLE OF FORMING CORROSIVE ACIDS WHEN THEY DISSOLVE IN WATER. THUS THE ATMOSPHERE SURROUNDING A PHOSPHORUS FIRE IS LIKELY TO BE ACIDIC. INHALATION OF THE FUMES OF BURNING PHOSPHORUS CAN LEAD TO SERIOUS LUNG INJURY WHEN THE OXIDES DISSOLVE IN THE LIQUID WITHIN THE LUNG AND ASSOCIATED PASSAGES. WHITE PHOSPHORUS IS ALSO KNOWN TO CAUSE PHOSSY JAW (PHOSPHORUS NECROSIS), A ROTTING OF THE JAWBONE.

THREE ANALYTICAL METHODS USED FOR THE DETECTION OF WHITE PHOSPHORUS, LISTED IN DESCENDING ORDER OF SENSITIVITY, ARE: NEUTRON ACTIVATION ANALYSIS, GAS-LIQUID CHROMATOGRAPHY, AND COLORIMETRY. THE MOST COMMONLY USED ANALYTICAL TECHNIQUE IN AQUATIC SURVEYS AND BIOASSAYS IS GAS-LIQUID CHROMATOGRAPHY.

TOXICOLOGY

IT IS KNOWN THAT WHITE PHOSPHORUS IS A POWERFUL SYSTEMIC POISON. IT IS ABSORBED THROUGH THE SKIN, BY INGESTION, AND THROUGH THE RESPIRATORY TRACT. THE LETHAL DOSE (ORAL INGESTION) IN ADULT HUMANS IS ABOUT 1 MG/KG BODY WEIGHT, BUT AS LITTLE AS 0.2 MG/KG BODY WEIGHT MAY PRODUCE TOXIC SYMPTOMS. SKIN CONTACT PRODUCES SEVERE AND PAINFUL BURNS, WITH DESTRUCTION OF THE UNDERLYING TISSUE. INHALATION OF VAPORS HAS PRODUCED TRACHEOBRONCHITIS AND LIVER ENLARGEMENT. THERE IS, HOWEVER, NO EVIDENCE THAT WHITE PHOSPHORUS IS CARCINOGENIC IN LABORATORY ANIMALS OR HUMANS. WHITE PHOSPHORUS IS A CLASS D CARCINOGEN. INSUFFICIENT EVIDENCE EXISTS TO DETERMINE WHETHER THIS COMPOUND CAUSES CANCER IN HUMANS, THEREFORE, CARCINOGENIC RISKS WERE NOT EVALUATED.

LOW CONCENTRATIONS OF ELEMENTAL PHOSPHORUS IN THE WATER COLUMN HAVE BEEN DOCUMENTED AS CAUSING ACUTE EFFECTS ON AQUATIC ORGANISMS. FISH APPEAR MORE SENSITIVE TO THE EFFECTS OF WHITE PHOSPHORUS THAN INVERTEBRATES. ANOTHER CONCERN IS THE IMPACTS OF CONTAMINATION THROUGH THE FOOD CHAIN. RAPID BIOACCUMULATION OF WHITE PHOSPHORUS HAS BEEN DOCUMENTED AND IS RELATED TO THE LIPID CONTENT OF THE ORGANISM. BIOCONCENTRATION FACTORS OF BETWEEN 20 AND 100 HAVE BEEN REPORTED FOR AQUATIC ORGANISM TISSUE.

WHITE PHOSPHORUS CONTAMINATION IN VARIOUS FISH TISSUES HAS BEEN SHOWN TO BE TOXIC OR LETHAL IF INGESTED. HOWEVER, DUE TO THE REACTIVITY OF WHITE PHOSPHORUS, THE TRANSFER OF THIS ELEMENT THROUGH THE FOOD CHAIN WOULD NOT BE EXPECTED. IN TERMS OF LONG TERM FOOD CHAIN CONTAMINATION, THE POTENTIAL FROM WHITE PHOSPHORUS IS CONSIDERED NIL.

TOXICITY TESTING WAS PERFORMED ON APPROXIMATELY TEN PERCENT OF THE SEDIMENT CORES FROM THE WPUMBA AREA TO DETERMINE THE EFFECTS OF WHITE PHOSPHORUS OR OTHER CONTAMINANTS THAT MIGHT BE PRESENT ON AQUATIC LIFE. A FRESHWATER AND AN ESTUARINE FISH SPECIES WERE UTILIZED DUE TO THE LOW SALINITIES FOUND AT THE WPUMBA SITE. IT WAS IMPORTANT TO TEST BOTH TYPES OF SPECIES, SINCE THIS SITE IS WITHIN THE RANGE OF THE SEASONALLY MOVING FRESHWATER/SALTWATER INTERFACE. MARINE, ESTUARINE, AND FRESHWATER FISH ARE PRESENT IN THE VICINITY DURING THE YEAR. THE FATHEAD MINNOW (*PIMEPHALES PROMELAS*) AND SILVERSIDE (*MENIDIA BERYLLINA*) WERE USED IN 96 HOUR ACUTE ELUTRIATE TESTS. THE MIDGE (*CHIRONOMUS TENTANS*), A BENTHIC INVERTEBRATE, WAS UTILIZED IN TEN-DAY ACUTE SOLID PHASE TESTS. THE TOXICITY TEST RESULTS DID NOT CLEARLY INDICATE ANY EFFECT OF SEDIMENT-BOUND WHITE PHOSPHORUS ON AQUATIC LIFE. IT APPEARS, THOUGH, THAT METALS PRESENT IN THE SEDIMENT SAMPLES MAY EXERT SOME TOXIC EFFECT ON AQUATIC LIFE AND, THEREFORE, MONITORING OF THE WATER COLUMN IN THE WPUMBA DURING DREDGING ACTIVITIES AND AFTER MAJOR STORM EVENTS (HURRICANE FORCE WINDS) WILL BE ACCOMPLISHED BY THE ARMY.

THE ABSENCE OR LOW LEVELS OF PHOSPHORUS DETECTED IN WPUMBA SEDIMENTS, COMBINED WITH PUBLISHED SOIL TOXICITY RESULTS, UTILIZING WORMS (*CHIRONOMIDS*), SUGGEST A LOW PROBABILITY OF WHITE PHOSPHORUS TOXICITY TO THE LOWER FOOD CHAIN ORGANISMS. BIOACCUMULATION TO AN UPPER LEVEL CONSUMER, SUCH AS WATERFOWL, HAS ALSO BEEN INVESTIGATED. AVIAN (BIRD) TOXICITY DATA IS MINIMAL, BUT THE LETHAL DOSE FOR PHOSPHORUS HAS BEEN CITED AS 3 MG/KG. SEVERAL FACTORS, THOUGH, SUGGEST THAT BIOACCUMULATION IN WATERFOWL MAY BE NEGLIGIBLE. MIGRATORY WATERFOWL USE THE WATERS IN THE APG VICINITY DURING THE WINTER SEASON. THEREFORE, EXPOSURE TO THE SMALL QUANTITIES OF PHOSPHORUS DETECTED SHOULD BE MINIMAL. ADDITIONALLY, WATERFOWL LIPID CONTENT DURING THE WINTER IS ELEVATED. THIS MAY SERVE TO ISOLATE ANY WHITE PHOSPHORUS INGESTED AND PREVENT MANIFESTATION OF ACUTE SYMPTOMS. FURTHERMORE, LARGE BIRDS RATHER THAN SENSITIVE PRECOCIAL YOUNG WOULD BE UTILIZING THE FOOD RESOURCES. FOR THESE REASONS, SUB-LETHAL EFFECTS ON WATERFOWL SHOULD BE ISOLATED OR OF A LOW PROBABILITY.

FATE AND TRANSPORT

THE PROCESSES BY WHICH WHITE PHOSPHORUS IS TRANSFORMED IN AIR, WATER, AND SOIL ARE OXIDATION, HYDROLYSIS, AND VOLATILIZATION. WHITE PHOSPHORUS IS NOT TRANSFORMED BY PHOTOLYSIS, AND IT IS ALSO RESISTANT TO BIODEGRADATION BY ANAEROBIC ORGANISMS. ALTHOUGH HYDROLYSIS AND VOLATILIZATION CAN HAVE SIGNIFICANT EFFECTS ON THE ENVIRONMENTAL FATE OF WHITE PHOSPHORUS, ITS FATE IN AIR, SOIL, AND WATER IS GENERALLY DETERMINED BY OXIDATIVE PROCESSES. SEVERAL INVESTIGATORS OBSERVED THAT THE PHOSPHORUS OXIDATION RATE IN AQUEOUS SYSTEMS CAN BE AFFECTED BY DISSOLVED OXYGEN CONCENTRATION, TEMPERATURE, PH, SALINITY, AND THE PRESENCE OF METALS.

THE PRIMARY PATHWAY OF THE DEGRADATION OF WHITE PHOSPHORUS AT SEDIMENT SURFACES IS BY OXIDATION, WITH THE RATE DEPENDENT UPON THE AVAILABLE OXYGEN. WHITE PHOSPHORUS IN SEDIMENT USUALLY WILL OXIDIZE TO THE MORE STABLE RED ALLOTROPE. WITH THE ABUNDANCE OF OXYGEN AT THE SEDIMENT-WATER INTERPHASE, WHITE PHOSPHORUS WILL BE PREDOMINANTLY OXIDIZED TO PHOSPHATES ROUGHLY WITHIN WEEKS TO MONTHS. SINCE SEVERAL OF THESE PHOSPHATE COMPOUNDS ARE POSSIBLE, FIXATION OF PHOSPHORUS PROBABLY TAKES PLACE OVER A RELATIVELY WIDE PH RANGE. ALSO, THE LARGE QUANTITIES OF HYDROUS IRON AND ALUMINUM OXIDES PRESENT IN MOST SEDIMENTS MAKE POSSIBLE THE FIXATION OF TREMENDOUS AMOUNTS OF PHOSPHORUS. HOWEVER, BECAUSE MOST SEDIMENTS ARE ANAEROBIC SHORT DISTANCES BELOW THE WATER-SEDIMENT BOUNDARY SURFACE, PHOSPHORUS DEGRADATION/OXIDATION MAY BE EXTREMELY LENGTHY AT SUCH DEPTHS. EXPERIMENTS DETERMINED THAT SURFACE

DEPOSITS OF ONLY A FEW PPM OF PHOSPHORUS OXIDIZE QUICKLY, WHEREAS DEEPER DEPOSITS OF HIGHER CONCENTRATION COULD REMAIN FOR YEARS. ANAEROBIC SEDIMENTS CAN, THEREFORE, SERVE AS SINKS FOR WHITE PHOSPHORUS THAT CAN, IN TURN, SERVE AS LONG-TERM SOURCES FOR MOBILIZATION OF WHITE PHOSPHORUS INTO THE ENVIRONMENT IF DISTURBED.

IN DETERMINING THE EFFECT OF THE PHOSPHORUS SEDIMENTATION PROCESS, THE INTERACTION OF THE PHOSPHORUS SPECIES WITH THE SEDIMENT PRESENT MUST BE UNDERSTOOD. IT APPEARS THAT IN SOME SEDIMENTS, PHOSPHORUS IS HELD IN A COMPLEX FORM INVOLVING IRON AS THE COMPLEXING METAL, THE STABILITY OF WHICH IS RELATED TO THE SALT CONTENT OF THE WATER. IT HAS BEEN DEMONSTRATED IN AN ESTUARY THAT THE AVAILABILITY OF PHOSPHORUS FROM SUCH SEDIMENTS DECREASES WITH INCREASING SALINITY. IT HAS BEEN SUGGESTED THAT SALTS COAGULATE THE COLLOIDAL PARTICLES PRESENT, THEREBY RETARDING SEDIMENT EXPOSURE TO OXYGEN. IT ALSO APPEARS THAT THE RATE AND QUANTITY OF PHOSPHORUS FIXATION DEPENDS ON THE TYPE OF SEDIMENT PRESENT. IT HAS BEEN REPORTED THAT NONCALCEROUS SEDIMENTS WILL ABSORB AND RETAIN MORE ADDED PHOSPHORUS THAN CALCEROUS LAKE SEDIMENTS.

IN AQUATIC SYSTEMS, PHOSPHORUS OXIDATION CAN BE AFFECTED BY THE CONCENTRATION ABOVE AND BELOW THE PHOSPHORUS SOLUBILITY LIMIT (3 MG/L AT 59 DEGREE FAHRENHEIT). THE ABILITY OF A SEDIMENT TO ABSORB ADDED PHOSPHORUS WILL DECREASE WITH AN INCREASE IN THE WATER-TO-SEDIMENT PHOSPHORUS CONCENTRATION. THIS MEANS THAT AS PHOSPHORUS IS ADDED TO THE WATER COLUMN, THE ABSORBING POWER OF THE SEDIMENT PEAKS AT A SPECIFIC RANGE, AND THEN DECREASES, LEAVING THE EXCESS CONCENTRATION OF PHOSPHORUS IN THE AQUEOUS PHASE. AT THE SAME TIME, IF THE WATER-TO-SEDIMENT PHOSPHORUS CONCENTRATION CONTINUES TO INCREASE, THE RETENTION CAPACITY OF THE SEDIMENT WILL DECREASE, WHICH WOULD ADD MORE PHOSPHORUS TO THE WATER. IN OPPOSITION, THE PERCENTAGE OF WHITE PHOSPHORUS REMOVED BY SEDIMENTS WILL INCREASE AT LOWER WATER-TO-SEDIMENT PHOSPHORUS CONCENTRATIONS. ITS APPEARS THAT WHITE PHOSPHORUS UNDERGOES OXIDATION DURING THIS PARTITIONING PHASE, AND THAT THE OVERALL EFFECT OF PHOSPHORUS BINDING TO SEDIMENTS DEPENDS ON WATER-TO-SEDIMENT PHOSPHORUS EQUILIBRIUM.

IN APPLYING THE ABOVE TO THE WPUMBA, PHOSPHORUS TENDING TO REMAIN IN THE WATER COLUMN WOULD BE INDICATIVE OF A SEDIMENT BEING OVERSATURATED WITH PHOSPHORUS AND RELEASING IT TO THE AQUEOUS ENVIRONMENT. HOWEVER, AT THE WPUMBA NO PHOSPHORUS WAS DETECTED IN THE WATER COLUMN ABOVE THE SUPPOSED BURIAL AREA. ADDITIONALLY, ONLY LOW CONCENTRATIONS OF PHOSPHORUS WERE DETECTED IN A FEW SEDIMENT CORE SAMPLES FROM THE WPUMBA. THE ENVIRONMENTAL RELEASE OF WHITE PHOSPHORUS SHOULD CAUSE VISIBLE CHANGES IN THE AQUATIC ECOSYSTEM. NO ADVERSE ENVIRONMENTAL STRESS WAS OBSERVED AT THE WPUMBA. ADDITIONALLY, WHITE PHOSPHORUS RELEASE TO THE ENVIRONMENT WOULD HAVE SOME ABIOTIC EFFECTS AS WELL, SUCH AS INCREASED ACIDITY AND DECREASED DISSOLVED OXYGEN. YET, NO ABNORMALITIES IN THE ABIOTA WERE FOUND AT THE WPUMBA. THUS, ONE CAN ASSUME THAT THE BOTTOM SEDIMENTS AT THE WPUMBA ARE NOT SATURATED WITH PHOSPHORUS AND AT PRESENT ARE NOT RELEASING PHOSPHORUS TO THE AQUEOUS ENVIRONMENT. LIKEWISE, THE SAME CAN BE ASSUMED IN THE CASE OF GROUNDWATER; IF THE BOTTOM SEDIMENTS ARE NOT SATURATED WITH PHOSPHORUS, THEN THERE IS NO REASON TO SUSPECT PHOSPHORUS RELEASES TO GROUNDWATER.

HOWEVER, IF IN THE FUTURE THE WATERS OFF APG START TO RECEIVE AN INCREASED AMOUNT OF PHOSPHORUS DUE TO THE ACCELERATING USE OF FERTILIZERS, THE BOTTOM SEDIMENTS AT THE WPUMBA COULD THEORETICALLY BECOME SATURATED WITH PHOSPHORUS. ALSO, BECAUSE OF DREDGING ACTIVITIES THAT OCCUR IN THE WPUMBA VICINITY, BOTTOM SEDIMENTS COULD BE DISTURBED, CAUSING THE RELEASE OF PHOSPHORUS TO THE ENVIRONMENT. WITH THIS IN MIND, THEREFORE, MONITORING OF THE WPUMBA DURING DREDGING ACTIVITIES AND FOLLOWING MAJOR STORM EVENTS (HURRICANE FORCE WINDS) WILL BE CONDUCTED BY THE ARMY.

THE NO EFFECT LEVEL FOR WHITE PHOSPHORUS IN SEDIMENT LIES BELOW 2 G/KG (WET WEIGHT). ALL PHOSPHORUS WET WEIGHT CONCENTRATIONS WERE BELOW 2 G/KG FOR THE EPA ERT INVESTIGATION. THIS INDICATES THAT THE SEDIMENT

CONTAINS NO EFFECT CONCENTRATIONS OF WHITE PHOSPHORUS. THE LACK OF DETECTABLE QUANTITIES OF PHOSPHORUS IN THE WATER COLUMN INDICATES THE STABILITY OF THE WHITE PHOSPHORUS IN THE SEDIMENTS. THE CURRENT US EPA "QUALITY CRITERIA FOR WATER" (1986) LISTS THE CRITERIA FOR TOTAL PHOSPHORUS AS 0.10 G/L FOR MARINE AND ESTUARINE WATERS. HOWEVER, IT IS POSSIBLE THAT UNDETECTED WHITE PHOSPHORUS COULD BE RELEASED TO THE WATER COLUMN DURING DISRUPTION OF THE SEDIMENT.

PERIODIC STORMS AND SHIFTS IN WINDS AND WAVES ARE THE CAUSE FOR CHANGES IN THE GEOMORPHOMETRIC PROCESSES OBSERVED BY AERIAL PHOTOGRAPHS AT THE SITE. AN EXAMINATION OF THE WIND ROSE AT APG INDICATES THAT WINDS WHICH MAY CAUSE ACCRETION OCCUR APPROXIMATELY 26 PERCENT OF THE TIME. WINDS WHICH MAY CAUSE EROSION OCCUR APPROXIMATELY 16 PERCENT OF THE TIME. THE WPUMBA IS SHELTERED FROM WINDS APPROXIMATELY 58 PERCENT OF THE TIME. WAVES OF SUFFICIENT HEIGHT AND ENERGY ARE REQUIRED TO CAUSE SIGNIFICANT GEOMORPHOMETRIC CHANGES AND ONLY OCCUR WITH HIGH WINDS. WINDS GREATER THAN 17 KNOTS IN THE EROSIONAL OR ACCRETING DIRECTIONS ONLY OCCUR ABOUT 1 PERCENT OF THE TIME. THIS INDICATES THAT SIGNIFICANT EROSION OR ACCRETION WOULD ONLY OCCUR DURING HIGH WINDS AND THE OCCASIONAL SEVERE STORM. THEREFORE, SIGNIFICANT SEDIMENT DISTURBANCE CAUSED BY STORMS IS LOW. DESCRIPTION OF THE "NO ACTION" REMEDY

THE EPA ERT INVESTIGATION OF THE WPUMBA DID NOT DISCOVER ANY SUPPOSED WHITE PHOSPHORUS BURIAL AREA WITHIN THE CONFINES OF THE STUDY LOCATION. BASED ON CURRENT SITE CONDITIONS, MINIMAL IMPACTS UPON THE AQUATIC ECOSYSTEM ARE EXPECTED. RELEASE OF ANY YET UNDETECTED LARGE AMOUNTS OF WHITE PHOSPHORUS IS NOT EXPECTED UNLESS THE SEDIMENTS ARE DISTURBED. LIKEWISE, BIOASSAY TECHNIQUES UTILIZING FISH DID NOT ELUCIDATE ANY CLEAR TOXIC EFFECT OF WHITE PHOSPHORUS ON AQUATIC LIFE. THESE RESULTS LEAD TO A CONCLUSION THAT ANY SAFETY OR ENVIRONMENTAL HAZARD WHICH MAY HAVE EXISTED IN THE PAST DUE TO THE WPUMBA NO LONGER EXISTS. IT IS STILL POSSIBLE, HOWEVER, THAT UNEXPLODED ORDNANCE OR OTHER SAFETY HAZARDS MAY EXIST WITHIN THE STUDY AREA. THE GOALS, THEREFORE, OF THE SELECTED REMEDIAL ACTION ARE TO LIMIT THE EXPOSURE OF THE AQUATIC ECOSYSTEM AND HUMAN POPULATION TO ANY BURIED MATERIAL CONTAINED IN THE WPUMBA, AND ARE TO BE ACCOMPLISHED THROUGH A MONITORING/SAMPLING PROGRAM. ADDITIONALLY, A FUTURE REVIEW OF THE TECHNOLOGY AVAILABLE FOR DETECTING AND LOCATING THE SUPPOSED WPUMBA WILL BE PERFORMED.

ANY SUPPOSEDLY BURIED WHITE PHOSPHORUS AT THE WPUMBA OR OTHER SEDIMENT-BOUND MATERIAL COULD BE RELEASED TO THE ENVIRONMENT IF THE SEDIMENT IS DISTURBED. THE ARMY WILL, THEREFORE, CONDUCT SAMPLING OF THE WATER COLUMN, PRIOR TO AND DURING ANY DREDGING ACTIVITIES IN THE AREA AND FOLLOWING MAJOR STORM EVENTS (HURRICANE FORCE WINDS), TO MONITOR AND MINIMIZE RELEASES OF SEDIMENT-BOUND MATERIALS TO THE ENVIRONMENT. WATER SAMPLES WILL BE ANALYZED FOR PHOSPHORUS, USING A DETECTION LIMIT OF 0.01 PPB WHICH IS 10 PERCENT OF THE ESTABLISHED AQUATIC TOXICITY CONCENTRATION, AND METALS UTILIZING APPROVED EPA QUANTITATION DETECTION LIMITS. A FIVE YEAR REVIEW WILL BE PERFORMED TO IDENTIFY POSSIBLE TECHNOLOGICAL ADVANCES THAT MIGHT BE DEVELOPED WHICH HAVE A GREATER DETECTION/LOCATION CAPABILITY FOR BURIED WHITE PHOSPHORUS THEN CURRENTLY EXISTS TODAY.

ALL ACTIVITIES AT THE WPUMBA WILL BE CONDUCTED IN COMPLIANCE WITH FEDERAL AND STATE LAW INCLUDING:

- * RIVERS AND HARBORS ACT OF 1899, SECTION 10
- * CLEAN WATER ACT OF 1972, AS AMENDED (33 USC 466), EMPHASIZING SECTIONS 115, 313(A), AND 404
- * FISH AND WILDLIFE COORDINATION ACT OF 1958 (16 USC 661 ET. SEQ.)
- * FISH AND WILDLIFE CONSERVATION ACT OF 1980
- * ENDANGERED SPECIES ACT OF 1973, AS AMENDED (16 USC 1531)

- * MIGRATORY BIRD ACT OF 1918
- * MIGRATORY BIRD TREATY ACT OF 1972 (16 USC 703-711)
- * COASTAL ZONE MANAGEMENT ACT OF 1972 (16 USC 1451), SEC. 307 C3
- * NATIONAL ENVIRONMENTAL POLICY ACT OF 1969 (42 USC 4321 ET. SEQ)
- * EXECUTIVE ORDER 11990